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EXACT ELECTRONICS, INC.

P. O. Box 234

Hillsboro, Oregon

INSTRUCTION MANUAL

Type 250 s/n ~~210~~

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IF YOUR INSTRUMENT DOES NOT OPERATE

PLEASE

1. Check operating procedure in manual for proper set-up.

2. Check fuse and power supply voltages.

3. Consult the brief trouble shooting guide at the beginning of the MAINTENANCE section of this manual.

4. Call your EXACT representative or the factory collect.

A new instrument should operate properly on arrival and no-one wishes this more than Exact. Many things keep this from happening in every case and if yours is the exception, you should be inconvenienced as little as possible. Some people like to find a trouble themselves, others prefer not to touch an instrument without representation from the manufacturer. **YOUR WARRANTY WILL IN NO WAY BE AFFECTED BY YOUR EFFORT TO FIND THE TROUBLE AND PUT YOUR INSTRUMENT IN EARLY OPERATION.** We leave it to your judgment and offer the services of our representatives and our factory to give you the assistance you need.

All Exact instruments are fully guaranteed against defective materials and workmanship for one year. Replacement parts requests should be clearly identified and the instrument serial number given. The needed parts will be air shipped to you within 24 hours.

Exact Electronics, Inc., was founded in July of 1957 for the purpose of supplying the needs of research, industry and government for precision calibration and waveform generating test equipment. We have dedicated ourselves to the continuing search for what is most needed in these fields and the best way to engineer and produce it.

A good deal of consideration was given before selecting the type of firm and kind of people we wanted to complete the communication between yourself and us. We're proud to suggest the following people as the ones for you to contact regarding application, purchasing or servicing of Exact instruments:

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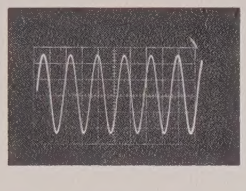
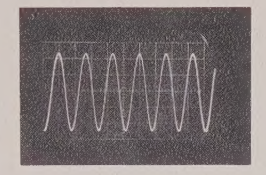
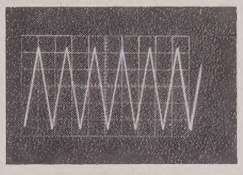
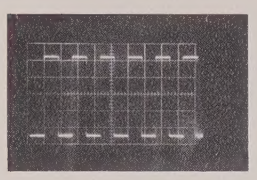
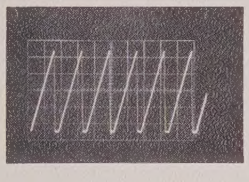
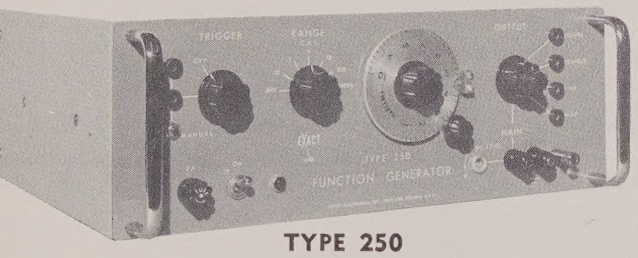
SINE – SQUARE – RAMP – TRIANGLE – COSINE

ELECTRO-MECHANICAL STUDIES
MULTIPLE WAVEFORM SOURCE
GEOPHYSICAL SIMULATION
ANALOG COMPUTER WORK
MEDICAL STIMULATION
QC AND CALIBRATION
SWEEP GENERATION
SERVO





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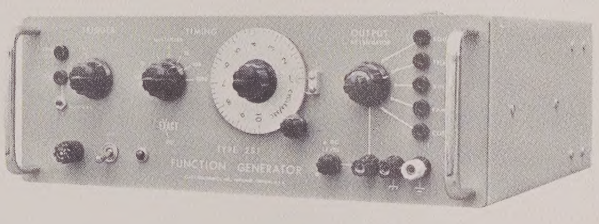


TYPE 251

TYPE 250/251 SPECIFICATIONS

	MAIN OUTPUT	AUXILIARY OUTPUTS
Amplitude	5 to 25 Volts	25 Volts
Amplitude Stability	Within 1%	Within 1%
Amp. Change with Freq.	½% from .001 to 1KC — 2% from 1KC to 10KC	TRI 5%
DC Reference (Center)	—13 to +13 Volts (Variable)	Approx. XXXX (Fixed) 0V
DC Reference Stability	Within 1%	Within 1%
Output Impedance	Cathode Follower (Approx. 200 Ω)	Cathode Follower
Output Current	15MA Above Ground to 7 MA Below Ground	5MA
Waveform Starts	Center Reference — Sine & Triangle Base Line — Square, Ramp & Cosine	

TRIGGERING

Internal Free Running
External (10V Signal) — WAVEFORM STARTS LESS THAN 1 μSEC.
Manual Push Button

TIMING

Range ..... .001 to 10KC
Continuous Var.
Dial Accuracy ..... Better Than 97%
Stability (Long Term) ..... Better Than 98%

GENERAL

Size: Cabinet ..... 5¼ x 15¼ x 15
Rackmount ..... 5¼ x 19 x 15
Shipping Carton:
7" x 17" x 20" 1.4 cu. ft.
Weight ..... 17 Pounds
(Packed 22 Pounds)
Power ..... 175 Watts
110/250 Volts 50-60 Cycles

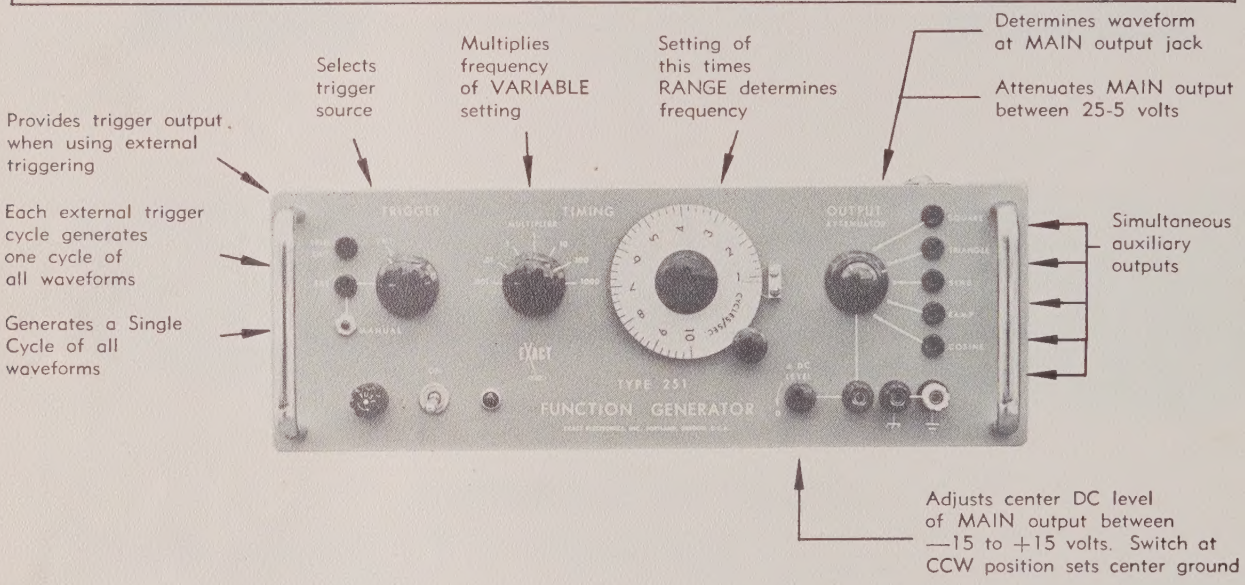
EXACT

EXACT ELECTRONICS, INC.
455 S. 2nd Ave. - P.O. Box 160 - HILLSBORO, OREGON
Phone: Midway 8-3590 Area Code: 503

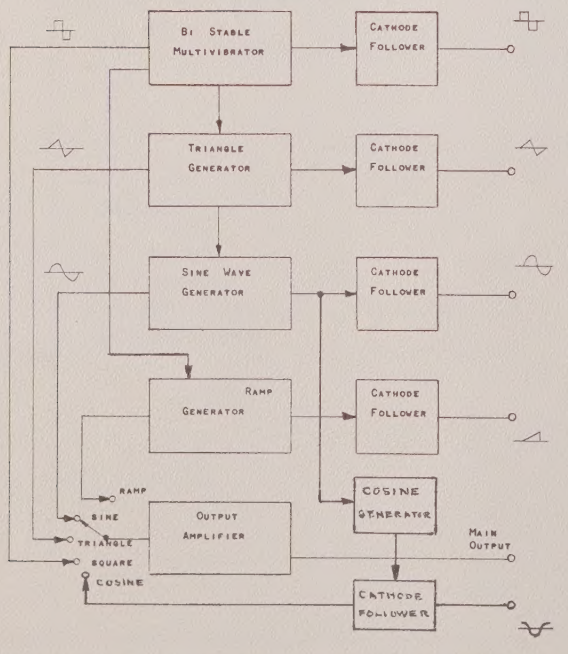
TYPE 250 & 251 FUNCTION GENERATORS

The **EXACT TYPE 250** generates five separate simultaneous outputs. The **EXACT TYPE 251** generates six separate simultaneous outputs. A SINE, SQUARE, TRIANGLE AND RAMP (and COSINE) waveform are each available from auxiliary jacks at 25V and 5MA. The MAIN output has available any one of the 4 (or 5) functions depending on the setting of the OUTPUT switch.

The center DC reference of the MAIN output may be varied from —15 to +15V or switched to ground. Available power is 25V (variable) at 15MA. The frequencies of all waveforms may be continuously varied from 0.001 cycles per second to 10KC. In addition to repetitive operation all of the waveforms may be manually triggered or powered from an external source. All waveforms are at the same amplitude and this amplitude is constant over the entire frequency range.


Selects trigger source
Multiplies frequency of VARIABLE setting
Setting of this times RANGE determines frequency
Determines waveform at MAIN output jack
Attenuates MAIN output between 25-5 volts
Provides trigger output when using external triggering
Each external trigger cycle generates one cycle of all waveforms
Generates a Single Cycle of all waveforms
Simultaneous auxiliary outputs
TRIGGER
TIMING
OUTPUT
EXACT
TYPE 251
FUNCTION GENERATOR
Adjusts center DC level of MAIN output between —15 to +15 volts. Switch at CCW position sets center ground

BLOCK DIAGRAM



OUTPUT VOLTAGES

RISETIME..... 5 μsec
SYMMETRY.....99%
OVERSHOOT.....1%
DROOP.....1%
LINEARITY.....99.5%
SYMMETRY.....99%

25V

DISTORTION
LESS THAN.....2%

25V

LINEARITY.....99.5%
FALL TIME.....3% of Period
LENGTH .....Adjustable

25V

DISTORTION
LESS THAN.....2%

25V

1-3 OPERATION

1-31 The general purpose of the Type 250 is to generate square, sine, triangle and ramp waves over a continuously variable frequency range of 0.001 cycles per second to 10 KC. These waveforms are available simultaneously from the designated jacks on the right hand side of the front panel or singly as selected from the main output jack. The waveforms may be continuous, externally triggered or triggered by the Manual push button.

1-32 For first time operation, follow this procedure:

*BE SURE UNIT HAS GOOD VENTILATION. DO NOT STACK BOOKS OR PAPERS ON TOP OF CABINET.

A. Turn power switch ON.

B. Set the OUTPUT switch to TRIANGLE.

C. Turn the OUTPUT ATTEN. (red concentric knob) fully CW.

D. Turn the ± DC LEVEL control all the way CCW until you are in the switched position.

E. Set the CYCLES/SECOND dial to 5.

F. Set the TIME MULTIPLIER to 100.

G. Set the TRIGGER switch to INT (off).

H. Connect the MAIN OUTPUT to a monitor scope.

I. Be sure that the CHASSIS ground post and the CABINET Ground post are shorted together.

J. Connect the TRIGGER OUT jack to the external trigger input of the monitor scope.

K. Set the monitor scope controls for:

External triggering
2 msec/cm time base
DC coupled input
5 volts/cm vertical deflection

1-33 You should be observing about 10 cycles of triangle waveform on the monitor scope. Try the following adjustments to become better acquainted with the front panel controls:

A. Switch the OUTPUT switch to each of the 4 waveforms and notice the stability of amplitude and DC level.

B. Turn the OUTPUT ATTEN. CCW (you should attenuate from 30 to approx. 5 volts).

C. Connect your main output lead from the scope to each of the four separate SQUARE, TRIANGLE, SINE AND RAMP waveforms. These amplitudes are fixed at 30 volts and their center DC reference levels are fixed at 0. (internal adjustments can change this level if desired).

D. Again observe the MAIN OUTPUT with the monitor scope and turn the ±DC LEVEL screwdriver adjust CW through its full range. The waveform should move from entirely below ground to entirely above ground.

E. Vary the CYCLES/SECOND and the TIME MULTIPLIER and observe the amplitude and DC level stability.

F. Turn the TRIGGER OUT switch to EXT (in) and apply a 10 volt trigger signal with better than a 10 usec rise-time. Also press the MANUAL trigger button. You will notice that the waveforms trigger at the following levels:

Square ---------- most negative
Sine ---------- center
Triangle --------- center
Ramp ---------- most negative

You now have your "PILOT'S LICENSE" and we hope you will enjoy the use of your FUNCTION GENERATOR. Should you have any trouble or want to do something special with the unit (everyone does), please call your local representative listed at the front of this manual or phone us collect.

1-4 TROUBLE TIPS

FUSE BLOWING ----------	Shorted rectifier diodes.
EXCESSIVE HUM, DRIFT OR JITTER ------	Power supplies out of regulation. Ground strap between chassis ground and circuit ground missing on front panel.
NO OUTPUT OR IMPROPER DC LEVEL OUT ---------	Trigger source in EXT position. Check DC level pot/switch.
TIMING OFF DISTORTED TRIANGLE ---	Bad V4 or V5. Triangle timing adjustments off.
RAMP INOPERATIVE OR SKIPPING ----------	Bad V10. Ramp length/level adjustments off.
SQUARE WAVE UNSYMMETRICAL --------	Square symmetry (2) adjustments off.
DISTORTED SINE WAVE ----	Bad V7. Sine adjustments off (all square & triangle adjustments will effect). Timing off.
MANUAL OR EXTERNAL TRIGGERING INOPERATIVE OR UNIT STILL RUNS CONTINUOUSLY IN EXT POSITION ----------	Bad V3. Open Diode D102.

1-5 APPLICATIONS

General waveform source for research, analog computers, systems checking.

Check out of recorders (Ramp - Triangle).

Source of sweep voltages for monitor scopes, recorders, etc. (Ramp).

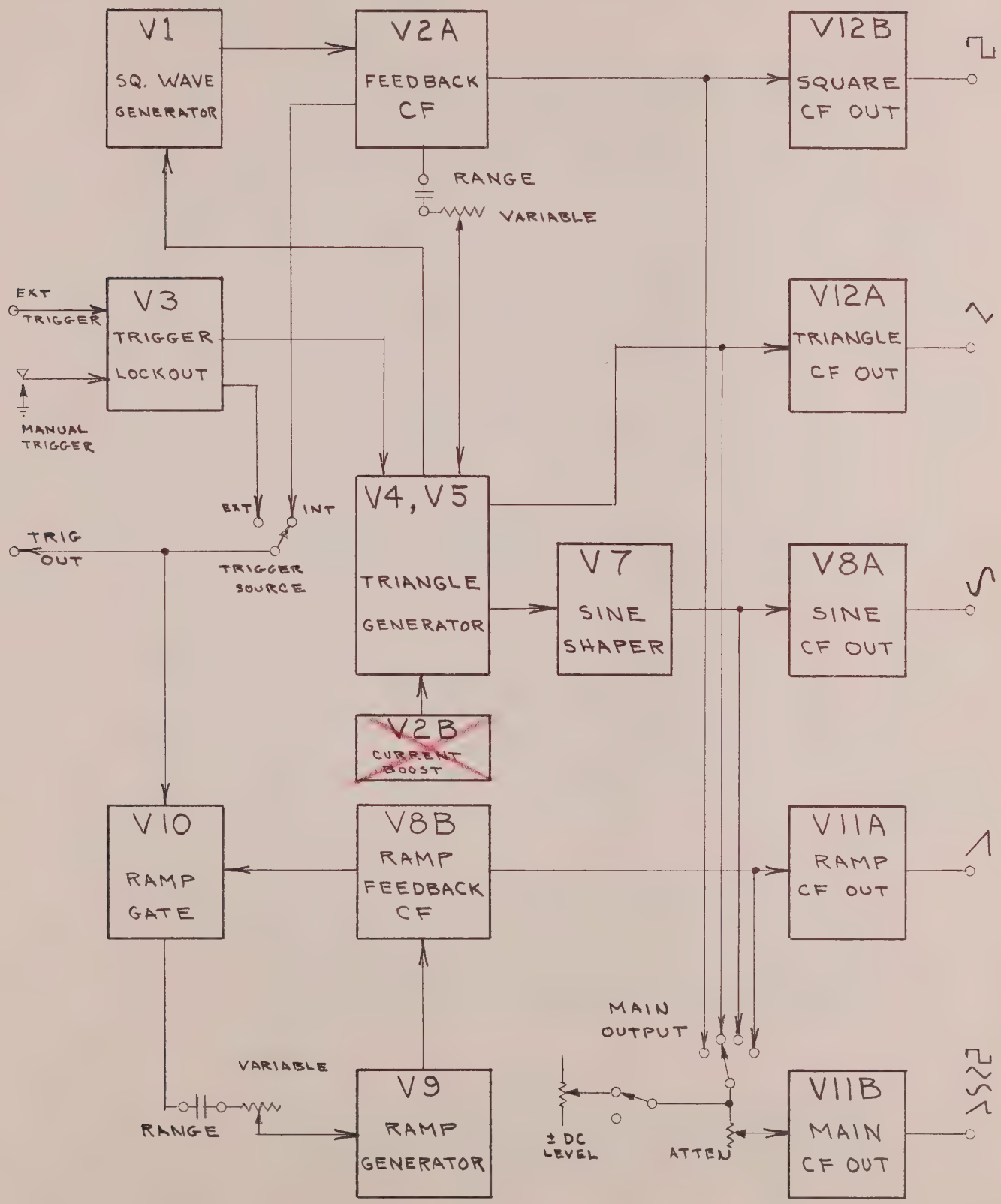
Low frequency square wave response check.

Triangle as raster generator.

Linearity checking of instruments or systems by varying DC level amplitude or frequency while holding one or both of the other parameters constant.

Delay trigger generator (trigger Type 250 externally and use square or ramp fall, which is variable over entire timing range) to trigger scope or other equipment.

TYPE 250 BLOCK DIAGRAM



2-2 TROUBLE SHOOTING PROCEDURE

2-21 POWER SUPPLY

All circuits depend on the regulated -210V, +100V & +250V. The more critical generating circuits also depend on the -11V filament regulation. Always check these supplies for proper voltage and below 10mv of ripple. (500mv on -11V supply.)

-210V problems check V103; V102; V101; -210 ADJ R23; Diodes D9-D12.

+100V problems check -210V; V104; V103; divider voltage pin 1, V104; diodes D5-D8.

+250V problems check -210V; V106; V105; divider voltage pin 1, V106; diodes D1-D4.

-11V problems check Q1; ZENER, D17; diode D18, diodes D13-D16.

2-22 SQUARE WAVE

V1 generates the square wave and also gates the triangle miller integrators V4 & V5. Problems involving square wave only should be traced to V12B, V2A and V1 in that order.

2-23 TRIANGLE

V4 & V5 are differential miller integrators and produce a positive and negative going voltage which is fed back to V1 to determine the flipping time of the multivibrator. Problems involving triangle only should be traced to V12A, V4, V5, R166 & R105 settings in that order.

2-24 SINE

V7 shapes the triangle and depends on accurate symmetry of the square wave and triangle as well as proper input level of triangle. All previous settings and calibration procedures should be checked before further trouble shooting the sine wave. After doing this, trace problem to V8A, V7, SINE SHAPE adjustments (R171, R172, R173) and SINE DC LEVEL R182 in that order.

2-25 RAMP

V10 is triggered by V1 (internal triggering) or V3 (external triggering) and furnishes the gate for miller integrator V9. Problems involving ramp only should be traced to V11A, V9, V8B, V10, RAMP LEVEL & RAMP LENGTH (R209 & R211) settings, D108 & D109 in that order.

2-26 MULTIPLE TROUBLES

Square Wave Symmetry Adjustments would cause malfunction of triangle and sine.

Switch contact problems could cause assorted malfunctions.

External trigger tube V3, holdoff level R136 and diode D104 could all cause lack of or improper external triggering.

Lack of main output could be V11B or the switch pot ±DC OUTPUT LEVEL.

2-3 CIRCUIT DESCRIPTION

2-31 POWER SUPPLY

The three power supplies are all based on the same principle; a DC amplifier is referenced to a standard voltage (a 5651 gas tube or precision dividers from -210V). Any variation from line or load is amplified by the DC amplifier and passed along as a control voltage to the series regulator tube. The filament supply is regulated by a transistor referenced to a zener diode.

2-32 SQUARE WAVE GENERATOR

V1 is a cathode coupled multivibrator. Its output (pin #6) swings from below -100V, when V1B is conducting, to +100V when it is cut off. The time duration of each half-cycle is determined by the triangle waveform at grid pin #9. The triangle from V4A is coupled back to the grid pin #9 of V1A. The triangle now determines the switching of the multivibrator V1. The triangle must always pass through the same DC levels to switch V1 and therefore this partly determines the timing of the instrument.

The Loop Gain of the cathode coupled multivibrator is determined by its cathode current. This determines the final timing and is controlled by R105.

V2A is a cathode follower whose putput has four parts.

a) SQUARE WAVE SYMMETRY (X10), R122 provides for equal voltage but opposite polarity at X10 end of VARIABLE (CPS) dial for each half-cycle of V1.

b) Provides standard SQUARE WAVE to output cathode follower V12B.

c) Provides square wave to Miller Integrator timing resistors and capacitors (R132-R135 and C102A-F).

d) Provides square wave to ramp gate V10 and "turn-off" voltage to external trigger multivibrator, V3.

2-33 TRIANGLE GENERATOR

V4A, V4B & V5A are push-pull Miller Integration amplifiers with an associated cathode follower. The symmetrical square wave from V2A is fed to grid pin #2 of V4A and the integrator action produces a triangle waveform at the cathode follower cathode (pin #8 of V4B). Time constants for the integrator are C102 (A-F), R124A and R132-R135. MILLER DC BAL (R166) determines the voltage level fed back to the grid of V1A and thus the DC level amplitude to V1.

2-34 SINE WAVE GENERATOR

V7 is a pentode whose bias characteristics are adjusted by three sine shaping adjustments, R171, R172 and R173. The linear triangle from V4B is shaped by these adjustments to produce a very low distortion sine wave at the plate pin #5.

SINE ADJ A controls the DC level of the grid.

SINE ADJ B controls the amplitude of the triangle into grid pin #1 of V7.

SINE ADJ C controls the suppressor bias of V7.

2-35 RAMP GENERATOR

V10 IS A CATHODE COUPLED MULTIVIBRATOR WHICH SHAPES THE RELATIVELY SLOW RISE SQUARE WAVE INPUT TO A FAST RISE GATE TO START THE MILLER INTEGRATOR V9. RUN-UP ACTION IS STARTED BY THE GATING PULSE FROM V10B. TIMING CONSTANTS ARE R124B, R203-R207 AND C115A-F. D108 AND D109 RETURN THE TIMING CAPACITOR TO THE PROPER QUIESCENT OPERATING LEVEL AFTER RUN-UP.

V8B FURNISHES THE NECESSARY PLATE TO GRID FEED BACK FOR THE INTEGRATOR AND IS ALSO THE CATHODE FOLLOWER TAKE OFF TO THE OUTPUT AMPLIFIER.

RAMP LENGTH (R211) DETERMINES THE NECESSARY VOLTAGE LEVEL TO RESET GATING MULTI V10 WHICH IN TURN STOPS THE RUN-UP AND TERMINATES THE RAMP.

2-36 MAIN OUTPUT

V11B IS A CONVENTIONAL CATHODE FOLLOWER. THE PROPER WAVEFORM BEING FED TO THE GRID IS SELECTED BY THE OUTPUT SWITCH, SW104. THE DC LEVEL OF THE CONTROL GRID IS DETERMINED BY:

A) R216, R217 IF ±DC OUTPUT LEVEL SWITCH IS CCW IN SWITCHED POSITION.

B) R214 IF ±DC OUTPUT LEVEL SWITCH IS CW FROM SWITCHED POSITION.

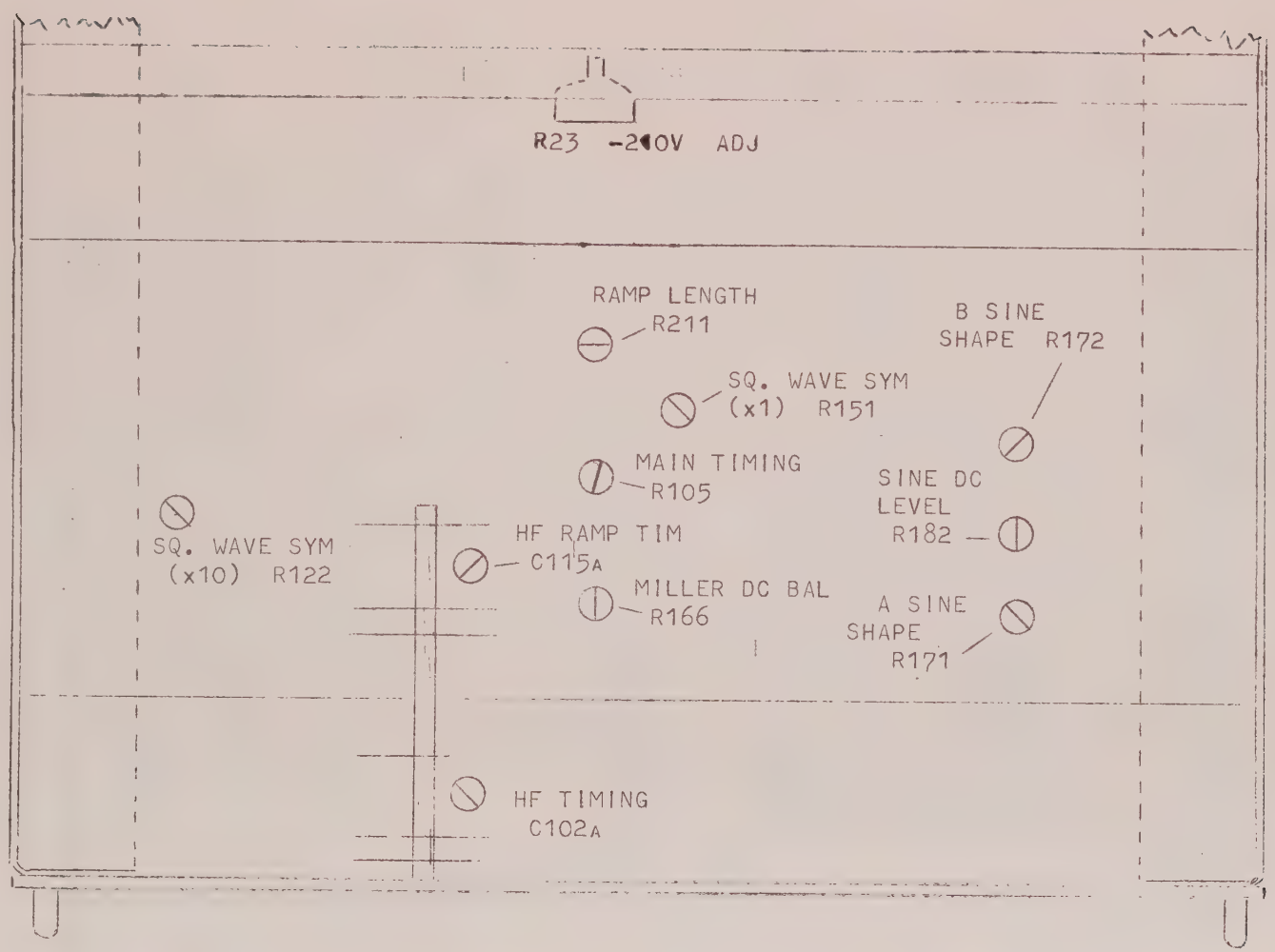
2-37 EXTERNAL TRIGGER

V3 IS A BI-STABLE MULTIVIBRATOR WHOSE OUTPUTS ARE USED TO:

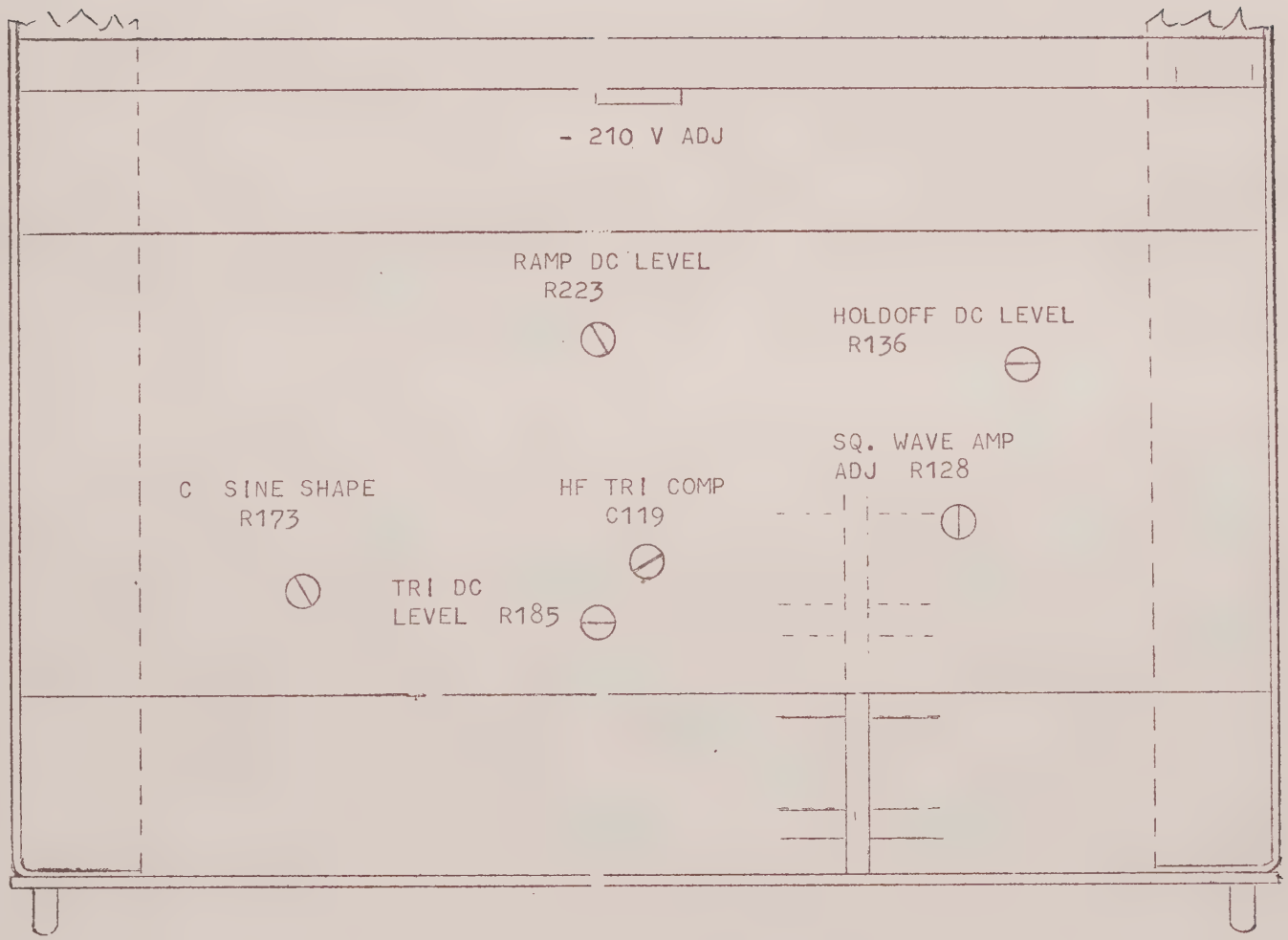
A) CLAMP THE TRIANGLE GENERATOR GRID (PIN #2, V4A) NEAR GROUND LEVEL WHICH STOPS OPERATION OF THE GENERATING CIRCUITS V1, V2, V4 AND V5.

B) PROVIDE A TRIGGER OUT PULSE AND A GATE TO V10A IN EXT TRIGGER OPERATION.

When the TRIGGER switch is in EXT position, the first negative going portion of the square at pin #7 of V3 will turn off that side of the tube. This will stop all internal triggering due to the clamp action at grid pin #2 of V4A. The negative going portion of an external or manual trigger at pin #2 of V3A will cause that half of the tube to cut off -- V3B will conduct and the clamp will be removed. Operation will continue for one cycle until the falling edge of the square wave again "locks out" V3.



TYPE 250 CALIBRATION ADJUSTMENTS TOP VIEW



TYPE 250 CALIBRATION ADJUSTMENTS BOTTOM VIEW

SECTION III CALIBRATION PROCEDURE

The following pieces of test equipment are recommended to give the Type 250 FUNCTION GENERATOR a complete calibration.

1. 20,000 ohm/volt voltmeter.
2. 100KC bandpass oscilloscope with DC coupled input and external triggering capabilities.
3. Variable line voltage input device such as a VARIAC.
4. Distortion analyzer or waveform analyzer such as DONNER or HEWLETT PACKARD manufacture.

3-1 POWER SUPPLY

TYPE 250

Strap between chassis gnd & circuit gnd
TRIGGER SOURCE -- EXT

3-11 MEASURE SUPPLY RESISTANCES TO GROUND

-210 volt -- approx. 5.5Kohms
+95 volt -- approx. 19Kohms
+250 volt -- approx. 60Kohms

TYPE 250

Plug AC input into VARIAC set to 117V
Power switch -- ON
TRIGGER SOURCE -- EXT

3-12 CHECK VOLTAGES

-210 volts -- adjust R23
+95 volts -- 5%
+250 volts -- 5%
- 11 volts (reg. filaments) -- 10%

TEST SCOPE

Vertical sens -- most sens position
Input coupling -- AC
Timing -- 10msec/cm
Trigger -- continuously running

3-13 CHECK RIPPLE AND REGULATION

Put test scope input lead on each of the power supplies while varying the line voltage from 105V to 125V. Ripple should be no greater than listed below throughout the input voltage range:

-210 volts -- 10mv
+100 volts -- 10mv
+250 volts -- 10mv
- 11 volts -- 500mv

3-2 TRIANGLE, SQUARE AND TIMING

TYPE 250
TRIGGER SOURCE -- INTERNAL
RANGE switch -- 100
Check VAR for mech center & set to 10
OUTPUT ATTEN -- full CW

TEST SCOPE
TRIGGERING -- INTERNAL
SWEEP TIME -- 1msec/cm
VERTICAL SENS -- 50V/cm
INPUT coupling -- DC

3-21 TRIANGLE BALANCE

Put scope probe on pin #2 of V4 and adjust MILLER DC BAL (R166) through range until stable, linear triangles appear on scope.

This adjustment will provide a triangle with good linearity. Timing at this point may not be correct, but following adjustments will give proper calibration.

INSTRUMENT SHOULD HAVE BEEN ON AT LEAST 15 MINUTES BEFORE ANY OF THE FOLLOWING ADJUSTMENTS ARE MADE:

3-22 TIMING (PRELIMINARY)

Put scope probe in triangle output and check for 10 triangles for 10cm on scope. Time by adjusting TIMING ADJ (R105).

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE switch -- 100
VARIABLE -- 10

TEST SCOPE

TRIGGERING -- INTERNAL
SWEEP TIME -- 100 usec/cm
VERTICAL SENS -- 10V/cm
INPUT coupling -- AC

3-23 SQUARE WAVE SYMMETRY

Connect test scope to SQUARE output of Type 250 and adjust scope triggering so that a change between plus and minus INTERNAL will cause a stationary polarity reversal of one cycle of the square wave.

Position the rise or fall to the center of the graticule and turn the scope magnifier ON. While switching the scope trigger between plus and minus INTERNAL triggering adjust SQUARE W. SYMMETRY (X10) R122 for no shift (equal positive and negative portions).

TYPE 250

Change VARIABLE to 1

TEST SCOPE

Change SWEEP TIME to 1msec/cm

Repeat the preceding calibration adjusting SQUARE W. SYMMETRY (X1) R151.

These two adjustments interact, so careful checking back and forth is necessary if either is adjusted more than a noticeable amount.

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE SWITCH -- 100
VARIABLE -- 10

TEST SCOPE

TRIGGERING -- EXTERNAL from SQUARE out
SWEEP TIME -- 1msec/cm
VERTICAL SENS -- 10V/cm
INPUT coupling -- AC

3-24 TIMING (FINAL)

With test scope on TRIANGLE OUTPUT and triggering scope from SQUARE output of Type 250 recheck TIMING (R105).

TYPE 250

Change VARIABLE to 1

TEST SCOPE

Change SWEEP TIME to 10msec/cm

Observe amount of error at this end of dial. Loosen set screw on dial knob and mechanically shift to compensate for error. DO NOT tighten screw until X10 end of dial has been rechecked.. R124A is very sensitive at X1 end, so be very careful.

TYPE 250

VARIABLE -- 1
Change RANGE to 1000

TEST SCOPE

Change SWEEP TIME to 100usec/cm

Adjust timing capacitor C102A for 1 cycle in 10cm.

Change variable to X10 and adjust C119 (H.F. TRI. COMP) for 10 cycles. Check variable at X1 and readjust C102A if necessary. Repeat adjust until X1 and X10 are tracking.

Check timing on all but the slowest two ranges by observing 10 cycles for 10cm.

TYPE 250

Change RANGE to .01

TEST SCOPE

SWEEP TIMING to 1sec/cm

Check timing by observing one cycle for 10cm

TYPE 250
Change RANGE to 10

TEST SCOPE
SWEEP TIME (decade) -- 1msec/cm
Calibrate the SWEEP TIME MULTIPLIER or VERNIER so that it gives a sweep 10 times slower than the decade step indicated on the scope.

TYPE 250
Change RANGE to .001

TEST SCOPE
Change SWEEP TIME (decade) to 1sec/cm
10sec/cm with vernier

Check for one cycld per 10cm
(Have patience!)

TYPE 250
TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE
TRIGGERING -- EXT from SQUARE out
SWEEP TIME -- 1msec/cm
VERTICAL SENS -- approx 10V/cm
INPUT coupling -- DC

3-25 TRIANGLE LEVEL & SQUARE WAVE AMPLITUDE

With test scope on SQUARE output adjust the vertical positioning and vertical gain of the test scope to present exactly 4cm of square wave with DC ground at the center (plus and minus 2cm of signal around ground).

With test scope monitoring TRIANGLE output and without touching any scope controls, adjust TRIANGLE DC level, R185, until the center DC level of the triangle wave matches the center DC level of the square wave.

Observe the amplitude of the triangle

With test scope monitoring SQUARE output, adjust SQUARE WAVE AMPLITUDE, R128, until the square wave is the same amplitude as the triangle.

3-3 TRIGGERING (LOCKOUT)

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE

TRIGGERING -- EXT from SQUARE out
SWEEP TIME -- 1msec/cm
VERTICAL SENS -- 10V/cm
INPUT coupling -- DC

With test scope on TRIANGLE output center the triangle waveform on the scope (DC ground -- center graticule = waveform center)

TYPE 250

Change TRIGGER SOURCE to EXTERNAL

TEST SCOPE

Change sweep to free run

With test scope on TRIANGLE output observe the DC shift of the trace as the VARIABLE dial on the 250 is rotated from 10 to 1. Adjust HOLDOFF DC LEVEL, R136, so that the shift is balanced about the center of the graticule.

TEST SCOPE

Change TRIGGERING to EXT

Connect the TRIGGER OUT of the Type 250 to the EXTERNAL trigger input of the scope. Apply a 10V signal from the scope calibrator to the EXT input of the Type 250. Adjust the test scope for triggered operation and check for proper triggering and output waveform from the Type 250. Remove the calibrator signal from the Type 250 and press the MANUAL button. You should observe one cycle of the waveform each time you press the button.

3-4 TRIANGLE LINEARITY

In this check it is very important to use a scope whose CRT geometry and linearity are calibrated to 1/2% or better. (Check scope linearity by looking at scope's SAWTOOTH OUT.)

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE

TRIGGERING -- +INTERNAL
SWEEP TIME -- 50usec/cm
VERTICAL SENS -- approx 10V/cm
INPUT coupling -- DC

With the test scope on TRIANGLE output set the scope vertical gain and sweep vernier to just display the rising half cycle of the triangle over the entire graticule area. Observe linearity.

TEST SCOPE

Change TRIGGERING to - INTERNAL

Observe linearity with just the falling half cycle of the triangle occupying the full graticule area of the test scope.

TYPE 250

Change VARIABLE to 1

TEST SCOPE

Change SWEEP TIME to 500usec/cm

Repeat the preceding check at the X1 end of the 250 VARIABLE dial.

If the nonlinearity is approaching 1%, try changing V4 and V5 and go through calibration steps 3-21, 22, 23 & 24.

Almost all the adjustments up to this point affect the shape of the sine wave. The pureness of the sine wave will depend on the accuracy of your previous calibration. Any subsequent changes or recalibration of previous steps will make it necessary for you to recheck the calibration of the sine wave.

3-5 SINE WAVE CALIBRATION (see photo 3-52)

Adjustment of the sine wave, if it is quite far out of tolerance, is as much an art as it is a science and you are asked to exercise tolerance and patience. (Checking with the photos of poorly adjusted sine waves will keep you from going too far astray.)

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE

TRIGGERING -- EXT from TRIGGER OUT
SWEEP TIME -- 200 to 500 usec/cm
VERTICAL SENS -- approx. 10V/cm
INPUT coupling -- DC

3-51 PRELIMINARY SETTINGS

With the test scope on the SINE output, adjust the scope triggering for stable EXT triggering from the TRIGGER OUT of the Type 250.

Adjust C SINE SHAPE, R175 CCW to ground.

Adjust A SINE SHAPE, R171 and B SINE SHAPE, R172 for the best looking sine possible. These adjustments are very interdependent and one can be at a setting where it is impossible for the other to correct. B SINE SHAPE controls more of the amplitude and A SINE SHAPE more of the shape itself. It is best to set B for nearly maximum amplitude, then as A is adjusted B can be reduced in amplitude to maintain proper shape. This is an optimum wave shape at this point.

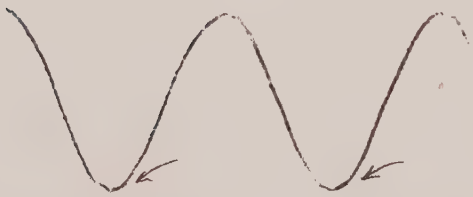
Now adjust C SINE SHAPE, R175, to round the bottom of the sine. A and B can be readjusted for final smoothing.

3-52

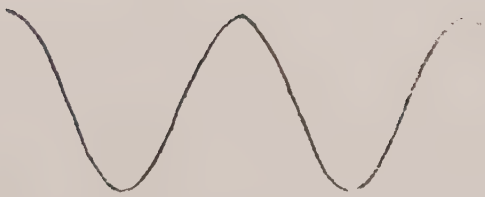
SINE ADJ B ABOUT CORRECT BUT SINE ADJ A TOO FAR CW. ROTATE "A" CCW UNTIL BOTTOM IS LESS FLAT AND TOP MORE FULL AND ROUND.

SINE ADJ B TOO FAR CCW. ROTATE CW UNTIL TOP IS PROPER SHAPE. IF BOTH TOP AND BOTTOM ARE FLAT, REDUCE AMPLITUDE WITH SINE ADJ B (CW ROTATION) AND ADJUST "A" TO RE-CENTER WAVEFORM (SYMMETRICAL SHAPE).

NOT ENOUGH ADJUSTMENT OF EITHER "A" OR "B". INCREASE AMPLITUDE (CW) WITH SINE ADJ B AND ADJUST "A" CW TO RE-CENTER WAVEFORM.



APPROXIMATELY OPTIMUM SETTING OF "A" AND "B" AND NOW AN ADJUSTMENT OF SINE ADJ C WILL ROUND THE BOTTOM OF THE WAVEFORM PROPERLY.



SINE ADJ C MADE PROPERLY. OPTIMUM SINE WAVEFORM.

IT WILL PAY TO THINK OF THE "B" ADJUSTMENT AS ADDING SIGNAL TO THE SHAPING CIRCUIT; CCW ROTATION CAUSING FLATTENING, CW ROTATION CAUSING TRIANGULAR SHAPE. "A" ADJUSTMENT CONTROLS DC LEVEL AND RE-CENTERS THE WAVE. "C" ADJUSTMENT SERVES TO SHAPE ONLY THE BOTTOM OF THE WAVEFORM.

3-53 FINAL ADJUSTMENT

Connect the SINE output of the Type 250 to a distortion analyzer or waveform analyzer. If you use a waveform analyzer the first 10 harmonics should be checked with adjustments made considering the first five.

Carefully adjust SINE SHAPE A, B & C for minimum harmonic distortion. You should be able to reduce the total to a maximum of 1%. Changing V7 and repeating calibration step 3-51 should be tried if you cannot make specifications.

TYPE 250
Change VARIABLE to 1

Check the distortion at this end of the dial for no more than 2%.

TYPE 250
Change VARIABLE to 10
Change RANGE to 1000

Check distortion at 10kc for no more than 2%.

TYPE 250
TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE
TRIGGERING -- EXT from TRIGGER OUT
SWEEP TIME -- 1msec/cm
VERTICAL SENS - approx 10V/cm
INPUT coupling -- DC

3-54 SINE DC LEVEL

Set the test scope trace for center graticule DC 0 volts (ground). Connect the test scope to the SINE output of the Type 250 and adjust SINE DC LEVEL (R182) until waveform is exactly centered on scope CRT.

3-6 RAMP CALIBRATION

TYPE 250
TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE
TRIGGERING -- EXT from TRIGGER OUT
SWEEP TIME -- 1msec/cm
VERTICAL SENS -- approx 10V/cm
INPUT coupling -- DC

With the test scope on the RAMP output, rough adjust RAMP LENGTH (R211) and RAMP DC LEVEL (R223) for a stable pattern DC balanced around ground. Fine adjust RAMP LENGTH (R211) for the same amplitude output as the other three waveforms.

Fine adjust RAMP DC LEVEL (R223) for center DC ground.

There should be a "hold-off" time of about 10% at the end of each ramp. This is normal and it is there to allow the ramp to fall and re-establish DC level before rising again, and to assure positive sync to the square wave generator.

TYPE 250
Change RANGE to 1000

TEST SCOPE
Change SWEEP TIME to 100usec/cm

Adjust timing capacitor (C115A) for 10 cycles in 10cm. (Note start of ramp and readjust if not linear.)

TYPE 250
Change VARIABLE to X1

TEST SCOPE
Change SWEEP TIME to 1msec/cm

Observe ramp amplitude and "hold-off" time (should be no more than 20% of total period).

TYPE 250
Change VARIABLE to 10
Change RANGE to 10
Change TRIGGER SOURCE to EXT

TEST SCOPE
Change SWEEP TIME to 10msec/cm

Press MANUAL trigger and check proper operation.

3-7 MAIN OUTPUT

TYPE 250
TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
MAIN OUTPUT -- SQUARE
OUTPUT ATTEN -- full CW
±DC level -- switched CCW to 0

TEST SCOPE
VERTICAL SENS -- 10V/cm
INPUT coupling -- DC
TIMING -- 1msec/cm
TRIGGER -- EXT from TRIGGER OUT

3-71 OUTPUT ATTEN.

With the test scope on MAIN OUTPUT, check for approx. 30 volt peak to peak signal (min. of 27 volts). Rotate the ATTEN. knob full CCW. Amplitude should decrease to approx. 5 volts (must go below 10V).

TEST SCOPE
Change VERTICAL SENS to 20V/cm

3-72 ±DC LEVEL

Turn ATTEN on Type 250 back full CW and center trace on scope screen. Turn ±DC LEVEL adjustment CW out of switched position and check range of adjustment for full below ground through above ground operation.

3-73 FUNCTION COMPARISON

Check all waveforms at MAIN OUTPUT for amplitude and DC level comparison within ±3%. (Sine wave may be as much as 5% lower.)

ABBREVIATIONS USED IN OUR PARTS LIST

Cer.	ceramic
Comp.	composition
EMC	electrolytic, metal cased
EMT	electrolytic, metal tubular
F	farad
H	henry
K	thousands of ohms
MEG	megohms
μ	micro
μμ	micromicro
M	milli
Prec.	precision
PT	paper tubular
Tub.	tubular
V	working volts DC
Var.	variable
W	watt
WW	wire wound

The column preceding the parts numbers contains the abbreviations of the manufacturers from whom we purchase the specified part. These abbreviations are listed below.

AB	Allen Bradley
AMX	Amperex
BL	Birnback
CD	Continental Device Corporation
CL	Clarostat
CRL	Centralab
CTC	Chicago Telephone Company
CTS	CTS Corporation
DUB	Cornell Dubilier
ER	Erie Electronics Div.
EX	Exact Electronics Inc.
GE	General Electric Company
GR	Grayhill
HL	Astron Corporation
IRC	International Resistance Corp.
OAK	Oak Electronics Corporation
OHM	Ohmite
PEN	Penn Resistor Corporation
RCA	Radio Corporation of America
RMC	Radio Materials Company
ST	Sarkes Tarzian Inc.
TI	Texas Instruments
TS	Tung-sol
WH	Westinghouse Electric

250 POWER SUPPLY

BULBS

B1	#47	6.3V				GE	150001

CAPACITORS

C1	80ufd	500V	EMC		SPR	290028
C2A&B	20/20ufd	450V	EMC		HL	290009
C3	80ufd	500V	EMC		SPR	290028
C4 A&B	20/20ufd	450V	EMC		HL	290009
C5 A&B	20/20ufd	450V	EMC		HL	290009
C6	.01ufd	200V		10%	AMX	285203
C7	.01ufd	200V		10%	AMX	285203
C8	.01ufd	200V		10%	AMX	285203
C9	2000ufd	20V	EMC		SPR	290029

DIODES

D1-D16	F4	400V			ST	152011
D17	VR10	10V	1W	10%	ST	152014
D18	CD1541	400V			CD	152010

RESISTORS

R1	120K	½W	Fixed	Comp	10%	AB	302124
R2	1M	½W	Fixed	Comp	10%	AB	302105
R3	100K	½W	Fixed	Comp	10%	AB	302104
R4	1.5M	½W	Fixed	Comp	10%	AB	302155
R5	10Ω	1W	Fixed	Comp	10%	AB	304100
R6	39K	½W	Fixed	Comp	10%	AB	302393
R7	680K	½W	Fixed	Comp	10%	AB	302684
R8	100K	½W	Fixed	Comp	10%	AB	302104
R9	1.5M	½W	Fixed	Comp	10%	AB	302155
R10	10	½W	Fixed	Comp	10%	AB	302100
R11	10	½W	Fixed	Comp	10%	AB	302100
R12	390K	½W	Fixed	Comp	10%	AB	302394
R13	47K	½W	Fixed	Comp	10%	AB	302473
R14	330K	½W	Fixed	Comp	10%	AB	302334
R15	1.5M	½W	Fixed	Comp	10%	AB	302155
R16	68K	1W	Fixed	Comp	10%	AB	304683
R17	200K	½W	Fixed	Prec	1%	PEN	309051
R18	165K	½W	Fixed	Prec	1%	PEN	309050
R19	100K	½W	Fixed	Prec	1%	PEN	309045
R20	210K	½W	Fixed	Prec	1%	PEN	309126
R21	150K	½W	Fixed	Prec	1%	PEN	309049
R22	100K	½W	Fixed	Prec	1%	PEN	309045
R23	10K	2W	Var	WW	-210V adjust	WL	311015
R24							
R25							
R26	270	2W	Fixed	Comp	10%	AB	306270
R27	25	5W	Fixed	WW	10%	OHM	308026

250 POWER SUPPLY

SWITCHES

SW1	Power Switch, SPST Toggle	BB	260134

TRANSISTORS

Q1	2N250	-11V Series regulator	TI	152001

VACUUM TUBES

V101	5651	Voltage reference	TS	154052
V102	6AU6	-210V DC amplifier	WH	154022
V103A	½-6080	+95V series regulator	TS	154056
V103B	½-6080	-210V series regulator	TS	154056
V104	6AU6	+95V DC amplifier	WH	154022
V105	12B4	+250V series regulator	TS	154045
V106	6AU6	+250V DC amplifier	WH	154022

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BULBS

B101	NE-2	200MA	60V	Neon		GE	150010

CAPACITORS

C100	4.7uufd	500V	Tub	Cer	10%	ER	281501
C101							
C102A	7-45uufd		Var	Cer		ER	281012
C102B	82uufd	500V	Tub	Cer	10%	ER	281528
C102C	.001ufd)						
C102D	.01ufd)		Matched timing capacitors			EX	285213
C102E	.1ufd)						
C102F	1ufd)						
C103	.001ufd	500V	Discap			RMC	283000
C104	22uufd	500V	Tub	Cer	10%	ER	281511
C105	.001ufd	500V	Discap			RMC	283000
C106	22uufd	500V	Tub	Cer	10%	ER	281511
C107	47uufd	500V	Tub	Cer	10%	ER	281519
C108	47uufd	500V	Tub	Cer	10%	ER	281519
C109	22uufd	500V	Tub	Cer	10%	ER	281511
C110	22uufd	500V	Tub	Cer	10%	ER	281511
C111	.01ufd	250V	Discap			RMC	283005
C112	22uufd	500V	Tub	Cer	10%	ER	281511
C113	12uufd	500V	Tub	Cer	10%	ER	281505
C114	.001ufd	500V	Discap			RMC	283000
C115A	7-45uufd		Var	Cer		ER	281012
C115B	82uufd	500V	Tub	Cer	10%	ER	281528
C115C	.001ufd)						
C115D	.01ufd)		Matched timing capacitors			EX	285213
C115E	.1ufd)						
C115F	1ufd)						
C116	.001ufd	500V	Discap			RMC	283000
C117	22uufd	500V	Tub	Cer	10%	ER	281511
C118	.01ufd	250V	Discap			RMC	283005
C119	4.5-25uufd		Var	Cer	10%	ER	281010
C120	22uufd	500V	Tub	Cer	10%	ER	281511
C121	.01 ufd	250V	Discap			RMC	283005
C122	.01 ufd	250V	Discap			RMC	283005
C123	12uufd	500V	Tub	Cer	10%	ER	281505
C124	.01ufd	250V	Discap			RMC	283005
C125							
C126	.01ufd	250V	Discap			RMC	283005

DIODES

D101	T155		TI	152009
D102-D109	CD1541	400V	CD	152010

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RESISTORS

R100	27K	1W	Fixed	Prec	1%	PEN	309107
R101	500K	½W	Fixed	Prec	1%	PEN	309140
R102	150K	½W	Fixed	Prec	1%	PEN	309049
R103	100K	½W	Fixed	Comp	10%	AB	302104
R104							
R105	5K	2W	Var	WW	Timing	CL	311012
R106							
R107	100	½W	Fixed	Comp	10%	AB	302101
R108	220K	½W	Fixed	Comp	10%	AB	302224
R109	10K	1W	Fixed	Prec	1%	PEN	309100
R110	100	½W	Fixed	Comp	10%	AB	302101
R111	470K	½W	Fixed	Comp	10%	AB	302474
R119	47K	2W	Fixed	Comp	10%	AB	306473
R120	100	½W	Fixed	Comp	10%	AB	302101
R121	15K	5W	Fixed	WW		W1	308108
R122	5K	2W	Var	WW Sq. W. Symmetry (X10)		CL	311012
R123	3.3K	2W	Fixed	Comp	10%	AB	306332
R124A & B	20K/30K	2W	Var	WW Multiplier (Var)		CTS	311309
R125	1.8K	½W	Fixed	Prec	1%	PEN	309001
R126	100K	½W	Fixed	Comp	10%	AB	302104
R127	27K	½W	Fixed	Comp	10%	AB	302273
R128	50K	.1W	Var	Comp Sq. W. Amplitude		CRI	311078
R129	82K	1W	Fixed	Comp	10%	AB	304823
R130	1.5K	½W	Fixed	Comp	10%	AB	302152
R131	220K	½W	Fixed	Comp	10%	AB	302224
R132	600K	½W	Fixed	Prec	1%	PEN	309142
R133	6M	½W	Fixed	Prec	1%	PEN	310720
R134	50M	½W	Fixed	Prec	1%	PEN	310730
R135	12M	½W	Fixed	Prec	1%	PEN	309267
R136	2M	.1W	Var	Comp Holdoff DC Level		CRI	311076
R137	820	½W	Fixed	Comp	10%	AB	302821
R138	27K	2W	Fixed	Comp	10%	AB	306273
R139	56K	½W	Fixed	Comp	10%	AB	302563
R140	22M	½W	Fixed	Comp	10%	AB	302226
R141	22K	½W	Fixed	Comp	10%	AB	302223
R142	56K	½W	Fixed	Comp	10%	AB	302563
R143	10K	½W	Fixed	Comp	10%	AB	302103
R144	100K	½W	Fixed	Comp	10%	AB	302104
R145	100K	1/8W	Fixed	Prec	1%	IRC	310714
R146	68K	1/8W	Fixed	Prec	1%	IRC	310713
R147	100K	1/8W	Fixed	Prec	1%	IRC	310714
R148	68K	1/8W	Fixed	Prec	1%	IRC	310713
R149	8.2K	1W	Fixed	Comp	10%	AB	304822
R150	1.5M	½W	Fixed	Comp	10%	AB	302155
R151	50K	1W	Var	Comp Sq. W. Symmetry (X1)		CTS	311023
R152	100K	½W	Fixed	Prec	1%	PEN	309045
R153							
R154	100	½W	Fixed	Comp	10%	AB	302101
R155	82K	2W	Fixed	Comp	10%	AB	306823
R156							
R157							
R158							
R159	150K	½W	Fixed	Comp	10%	AB	302154

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R160	100	½W	Fixed	Comp	10%	AB	302101
R161	100K	½W	Fixed	Prec	1%	PEN	309045
R162	100	½W	Fixed	Comp	10%	AB	302101
R163	100	½W	Fixed	Comp	10%	AB	302101
R164	100	½W	Fixed	Comp	10%	AB	302101
R165	200K	1W	Fixed	Prec	1%	PEN	310723
R166	15K	1W	Var	Comp	Bottom Triangle	CTS	311303
R167	27K	½W	Fixed	Prec	1%	PEN	309107
R168							
R169							
R170	150K	½W	Fixed	Prec	1%	PEN	309049
R171	50K	2W	Var	Comp	A Sine Shape	AB	311023
R172	10K	1W	Var	Comp	B Sine Shape	CTS	311015
R173	600K	½W	Fixed	Prec	1%	AB	309142
R174	150K	½W	Fixed	Prec	1%	PEN	309049
R175	50K	¼W	Var	Comp	C Sine Shape	CTS	311077
R176	1K	½W	Fixed	Comp	10%	AB	302102
R177	1M	½W	Fixed	Comp	10%	AB	302105
R178	330K	½W	Fixed	Prec	1%	AB	309101
R179	150K	½W	Fixed	Comp	10%	AB	302154
R180	2.7M	½W	Fixed	Comp	10%	AB	302275
R181	8.2M	½W	Fixed	Comp	10%	AB	302825
R182	1.5M	1W	Var	Comp		CTS	311042
R183	1.5M	½W	Fixed	Comp	10%	AB	302155
R184	120K	½W	Fixed	Comp	10%	AB	302124
R185	50K	.1W	Var	Comp	Triangle DC Level	CRI	311078
R186	47K	½W	Fixed	Comp	10%	AB	302473
R187	47K	2W	Fixed	Comp	10%	AB	306473
R188	47K	2W	Fixed	Comp	10%	AB	306473
R189							
R190	120K	½W	Fixed	Comp	10%	AB	302124
R191	100	½W	Fixed	Comp	10%	AB	302101
R192	3.9K	1W	Fixed	Comp	10%	AB	304392
R193	390K	½W	Fixed	Comp	10%	AB	302394
R194	470K	½W	Fixed	Comp	10%	AB	302474
R195	100	½W	Fixed	Comp	10%	AB	302101
R196	15K	2W	Fixed	Comp	10%	AB	306153
R197	680	½W	Fixed	Comp	10%	AB	302680
R198	100	½W	Fixed	Comp	10%	AB	302101
R199	27K	1W	Fixed	Comp	10%	AB	304273
*R200	100K	1W	Fixed	Comp	10%	AB	304104
R201	120K	½W	Fixed	Comp	10%	AB	302124
*R202	2.7K	1W	Fixed	Comp	10%	AB	304272
R203	1.2M	½W	Fixed	Prec	1%	PEN	309149
R204	12M	½W	Fixed	Prec	1%	PEN	309267
R205	20M	1W	Fixed	Prec	1%	PEN	310724
R206	50M	2W	Fixed	Prec	1%	PEN	310730
R207	50M	2W	Fixed	Prec	1%	PEN	310730
R208	15K	2W	Fixed	Comp	10%	AB	306153
R209	150K	½W	Fixed	Comp	10%	AB	302154
R210	150K	½W	Fixed	Comp	10%	AB	302154
R211	15K	1W	Var	Comp	Ramp Length	CTS	311303
R212	10K	2W	Fixed	Comp	10%	AB	306103
R213	4.7K	½W	Fixed	Comp	10%	AB	302472
R214	50K	1W	Var	(Part of ±DC Level SW105)		CTC	311025

*Nominal Value

250 MAIN GENERATOR

R215	27K	2W	Fixed	Comp	10%	AB	306273
R216	1K	1W	Fixed	Comp	10%	AB	304102
R217	100K	1W	Fixed	Comp	10%	AB	304104
R218	100K	2W	Var	Comp	Output Atten	AB	311026
R219	4.7K	½W	Fixed	Comp	10%	AB	302472
R220	47K	½W	Fixed	Comp	10%	AB	302473
R221	27K	2W	Fixed	Comp	10%	AB	306273
R222	47K	2W	Fixed	Comp	10%	AB	306473
R223	50K	.1W	Var	Comp	Ramp DC Level	CRI	311078
R224	180K	2W	Fixed	Comp	10%	AB	306184
R225	100	½W	Fixed	Comp	10%	AB	302101
R226	47K	½W	Fixed	Comp	10%	AB	302473
R227	3.3M	½W	Fixed	Comp	10%	AB	302335

SWITCHES

SW101	SPST Push Button	Manual Trigger	GR	260247
SW102	3 Wafer, 2 pos, rotary	Trigger Mode	OAK	260002
SW103	6 Wafer, 7 pos, rotary	Timing	OAK	260000
SW104	1 Wafer, 4 pos, rotary	Output Selector	OAK	260001
SW105	±DC Level (ganged with R214)		CTC	311025

VACUUM TUBES

V1	6U8A	Square Wave Generator	RCA	154033
V2A	½6U8A	Miller Feedback CF	RCA	154033
V2B				
V3	12AU7	External Trigger Lockout Multi	AMX	154041
V4A	½6BL8	Miller Integrator	AMX	154057
V4B	½6BL8	Miller Integrator CF	AMX	154057
V5A	½6BL8	Miller Integrator	AMX	154057
V5B				
V6				
V7	12AU6	Sine Shaper Amplifier	WH	154044
V8A	½6DJ8	Sine Out CF	AMX	154187
V8B	½6DJ8	Ramp Miller CF	AMX	154187
V9	6AU6	Ramp Miller Integrator	WH	154022
V10	6U8A	Ramp Gate	RCA	154033
V11A	½6AW8A	Ramp Out CF	TS	154095
V11B	½6AW8A	Main Output CF	TS	154095
V12A	½6DJ8	Triangle Out CF	AMX	154187
V12B	½6DJ8	Square Out CF	AMX	154187

FUNCTION - SQUARE WAVE - PULSE CODE - CALIBRATION

GENERATORS

SWEEP GENERATION

COMPUTER PROGRAMMING

STAIRSTEP GENERATION

FORCING FUNCTION GENERATION

SCOPE AND METER CALIBRATION

VIBRATION AND SHOCK GENERATION

SUBTRACTION OF ERROR SIGNAL AND NOISE

MEDICAL SIMULATION AND STIMULATION

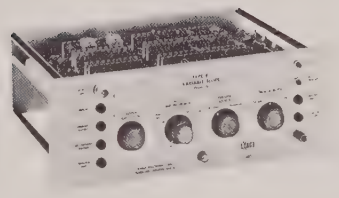
PCM - PAM - PWM - FMFM SIMULATION

GENERAL WAVEFORM SYNTHESIS

TEST QC AND CALIBRATION

DISTORTION ANALYSIS

SERVO PROGRAMMING



EXACT

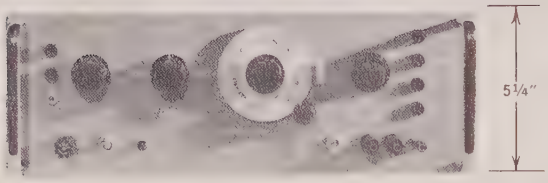
EXACT ELECTRONICS, INC.

455 So. 2nd Street • P.O. Box 160

Hillsboro, Oregon

PHONE: Midway 8-3590 AREA CODE: 503

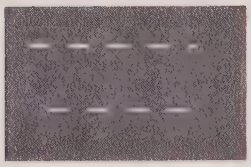
TYPE 250 FUNCTION GENERATOR



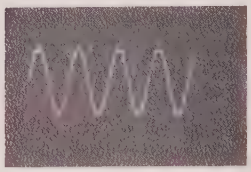
Multiple Waveform Source

Analog Computer Programming
Geophysical Simulation
Mechanical Studies
Medical Stimulation
QC and Calibration
Sweep Generation

SQUARE

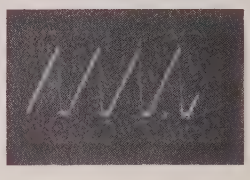


SINE



TRIANGLE

RAMP



SIMULTANEOUS USE OF ANY OR ALL FOUR WAVEFORMS

0.001 to 10 KC RANGE, continuously variable.

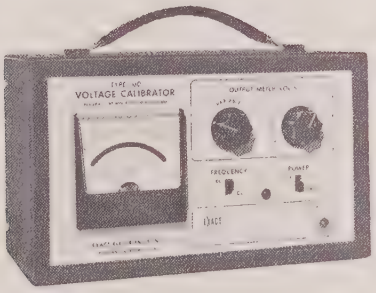
EXTERNAL TRIGGERING, manual triggering, and continuous operation.

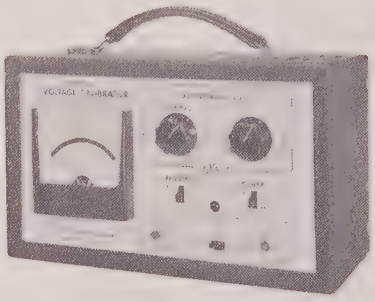
VARIABLE REFERENCE LEVEL for above and below-ground wave-forms.

25V at 15MA main output

LESS THAN 2% AMPLITUDE variation.

*A cosine waveform is available in the model 250-C





SCOPE CALIBRATION
METER CALIBRATION
UNKNOWN VOLTAGE COMPARISON

The output from the Type 100 is a IKC positive going square wave or a positive DC level depending on your need. A ½ % meter is connected directly across the output so that any external loading will give you an accurate reading of true output voltage. 0.05% divider resistors are used in the output to provide an overall accuracy of ¾ %. Since the meter is at the output, failure or drift of any component will not affect the true reading of output voltage.

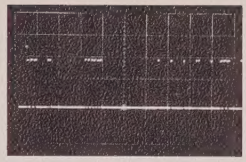
The Type 105 combines the circuitry and operation of the Type 100 with an internal chopper comparator. An input signal from 2mv to 100V (20mv to 600V with a compensated 10x divider) is mixed at a 60-cycle rate with the internal calibrator signal and the resultant output can be observed on a monitor oscilloscope.

TYPE 100 105 VOLTAGE CALIBRATORS

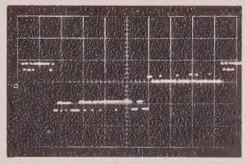
PULSE CODE GENERATORS

THE TYPE 200 WITH TYPE C VARIABLE WIDTH PLUG-IN GENERATES A SEQUENCE OF 50 SEPARATE VOLTAGE LEVELS OR INCREMENTS. THE MAIN FEATURE OF THE "C" UNIT IS THAT EACH OF THESE 50 INCREMENTS IS SEPARATELY ADJUSTABLE IN WIDTH. You may vary two other parameters simultaneously: (1) The individual amplitude of each increment from 0 to 30 volts. (2) The duration of all the increments as a group from 20 usec. to 50 sec. The rise and falltimes of the individual levels are 0.3 usec. Each increment may be manually triggered, externally triggered or triggered at the internal rate. You may also trigger each row of 10 increments or the full program of 20 to 50 increments in the same manner. Output amplitude and DC reference level of the output may be continuously varied to produce 0 to 30 volts at 10 ma between —15 volts and +30 volts.

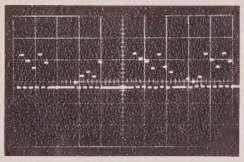
THE TYPE 200 WITH TYPE E 100 INCREMENT PLUG-IN GENERATES A SEQUENCE OF 100 SEPARATE VOLTAGE LEVELS OR INCREMENTS. THE MAIN FEATURE OF THE "E" UNIT IS THE ABILITY TO GENERATE A PROGRAM OF 100 VOLTAGE LEVELS. You may vary two other parameters simultaneously: (1) The individual amplitude of each increment from 0 to 30 volts. (2) The duration of all the increments as a group from 20 usec. to 100 sec. The rise and falltimes of the individual levels are 0.3 usec. Each increment may be manually triggered, externally triggered or triggered at the internal rate. You may also trigger each row of 10 increments or the full program of 20 to 100 increments in the same manner. Output amplitude and DC reference level of the output may be continuously varied to produce 0 to 30 volts at 10 ma between —15 volts and +30 volts.



PCM-PWM TELEMETRY

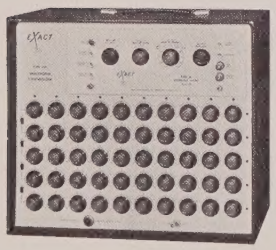


STAIRSTEP AND CODE TRANSMISSION



PAM

TYPE 200 WAVEFORM SYNTHESIZER AND TYPE A C E F PLUG-IN GENERATORS



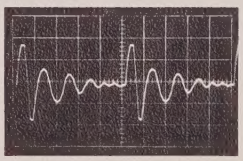
COMPLEX WAVEFORM GENERATORS

THE TYPE 200 WITH TYPE A VARIABLE SLOPE PLUG-IN GENERATES A SEQUENCE OF 50 INDIVIDUALLY ADJUSTABLE SLOPE SEGMENTS. THE MAIN FEATURE OF THE "A" UNIT IS THAT EACH OF THESE 50 INCREMENTS MAY BE INDEPENDENTLY VARIED IN SLOPE AND VOLTAGE LEVEL ALLOWING DISCONTINUOUS WAVEFORMS TO BE GENERATED: The voltage level of each may be varied from 0 to 40 volts and the slope adjusted + and —5 volts pivoting from the center of each increment.

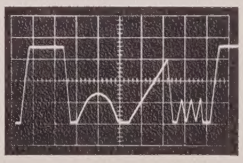
The duration of all the increments as a group may be varied from 33 usec. to 50 sec. External triggering or manual triggering is not available in this unit but a SYNC output is available to trigger other equipment. Output amplitude and DC reference level of the output may be continuously varied to produce 0 to 50 volts at 10 ma between —25 volts and +50 volts. Two simultaneous but separate auxiliary outputs of 50 increments are also available at 10 volts and 5 ma.

THE TYPE 200 WITH TYPE F VARIABLE SLOPE PLUG-IN GENERATES A SEQUENCE OF 50 INDIVIDUALLY ADJUSTED SLOPE SEGMENTS. THE MAIN FEATURES OF THE "F" UNIT ARE THE + AND —25 VOLT RANGE OF EACH SLOPE, THE TOTAL LACK OF DISCONTINUITY BETWEEN SLOPE SEGMENTS AND THE TRIGGERING FLEXIBILITY. The individual slope of each increment may be varied over a 50 volt range and the duration of all the increments as a group may be varied from 33 usec. to 50 sec.

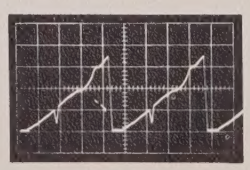
Each increment may be manually triggered, externally triggered or triggered at the internal rate. You may also trigger each row of 10 increments or the full program of 20 to 50 increments in the same manner. Output amplitude and DC reference level of the output may be continuously varied to produce 0 to 50 volts at 10 ma between —25 and +50 volts. Two simultaneous but separate auxiliary outputs of 50 increments are also available at 10 volts and 5 ma.



WAVEFORM ANALYSIS DISTORTION STUDIES



GENERAL RESEARCH ANALOG COMPUTOR SERVO ANALYSIS/TEST



COMPENSATION FOR DISTORTION OR SYSTEM NON-LINEARITY

EXACT

Exact Electronics, Inc., P. O. Box 160, Hillsboro, Oregon MI 8-3590

CAT #11 March 1962 Prices and specifications subject to change without notice

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